



Munich Personal RePEc Archive

Studying the Socio-Economics of Ageing using Social Accounting and Socio-Demographic Matrices. An application to Portugal.

Susana Santos

ISEG (School of Economics and Management) of the Technical
University of Lisbon, UECE (Research Unit on Complexity and
Economics) , DE (Department of Economics)

February 2014

Online at <http://mpra.ub.uni-muenchen.de/53858/>

MPRA Paper No. 53858, posted 26. February 2014 07:38 UTC

Studying the Socio-Economics of Ageing using Social Accounting and Socio-Demographic Matrices. An application to Portugal.

Susana Santos¹

ISEG (School of Economics and Management) of the Technical University of Lisbon

UECE (Research Unit on Complexity and Economics) and DE (Department of Economics).

Abstract

In looking for empirical evidence about the activity of countries, a proposal is made for studying (measuring and modelling) the activity of countries through the use of Social Accounting Matrices (SAMs) and Socio-Demographic Matrices (SDMs).

SAMs and SDMs are presented as tools that have specific features for conducting studies in several different areas, particularly in the Socio-Economics of Ageing, as well as for supporting policy decision processes.

Based on methodological principles that are derived mainly from the works of Richard Stone, emphasis is placed on the desirability of working in a matrix format, which includes not only people (SDM), but also, at the same time, activities, products, factors of production and institutions (SAM). This is considered to be a way of capturing the relevant network of linkages and the corresponding multiplier effects for the subsequent modelling of the activity of the countries studied.

The exposition of this proposal is accompanied by an example applied to Portugal.

Keywords: Social Accounting Matrix; Macroeconomic Policy; Socio-Demographic Matrices.

JEL classification: E16; E61; J11

(February 2014)

Notes:

- The financial support from national funds provided by FCT (*Fundação para a Ciência e a Tecnologia*), Portugal, is gratefully acknowledge. This paper is part of the Strategic Project for 2011-13 (PEst-OE/EGE/UI0436/2011).
- This paper was presented to the 3rd International Workshop on the Socio-Economics of Ageing, held in Lisbon – Portugal on 25/10/2013.

¹ Address for correspondence: ISEG /ULisboa, Rua Miguel Lupi, 20, 1249-078 Lisboa, Portugal (ssantos@iseg.ulisboa.pt).

CONTENTS

1. Introduction 1

2. Approaches based on SAMs and SDMs 1

3. Studying the Socio-Economics of Ageing with SAMs and SDMs 4

4. Concluding remarks 12

References 13

1. Introduction

The Social Accounting Matrix (SAM) and the Socio-Demographic Matrix (SDM) are tools that have specific features intended for studying the activity of countries. Both matrices cover movements in time and space, which are expressed by the former matrix in units of currency and by the latter matrix in terms of human beings.

Such features allow for the reading and interpretation of the reality under study, leading to the production of an empirical work that is not only capable of highlighting specific aspects of that activity, but also offers the chance to experiment with different interventions in regard to its functioning.

A proposal is made for the development both of a basic SAM and of a standard SDM in Santos, 2013. Together with an explanation of possible alternative taxonomies, this presentation shows how those matrices can be used as an alternative support for studies being undertaken in several areas, as well as for the work of those taking part in the policy decision process. Drawing upon the presentation made in that work, this paper seeks to illustrate a way of using those tools in studies undertaken in the area of the Socio-Economics of Ageing.

Section 2 outlines the main features of the SAM and SDM-based approaches, adopting a methodological framework that is based on Richard Stone's works. According to this methodological framework, SAMs and SDMs can describe the activity of countries either empirically or theoretically, depending on whether they are presented in a numerical or an algebraic version, respectively.

Using the example of an application to Portugal, Section 3 shows how those approaches can be used as an alternative support for studying the Socio-Economics of Ageing at a macroeconomic level, as well as for the work of those involved in the policy decision process.

Some concluding remarks will be made in Section 4.

2. Approaches based on SAMs and SDMs

Richard Stone worked largely with SAMs and SDMs as matrix formats of the national and demographic accounts. Besides numerical versions, he identified algebraic versions of those same matrices, which were worked on mainly under the scope of input-output analysis. In keeping with that work, and due to their similarities, we will call the approach based on SAMs the SAM-based approach – the term that is normally adopted – and the approach based on

SDMs the SDM-based approach – a term that is not normally adopted, but which will be used here.

Following the work of Richard Stone, Graham Pyatt and Jeffrey Round in particular played a key role in the study and dissemination of the SAM-based approach.

In the foreword to the book that can now be regarded as a pioneering work in terms of the SAM-based approach, “Social Accounting for Development Planning with special reference to Sri Lanka”, Stone stated that the framework of the system of national accounts can be rearranged and “the entries in a set of accounts can be presented in a matrix in which, by convention (...), incomings are shown in the rows and outgoings are shown in the columns; and in which, reflecting the fact that accounts balance, each row sum is equal to the corresponding column sum”. That matrix, with an equal number of rows and columns, is the SAM, in the construction of which “it may be possible to adopt a hierarchical approach, first adjusting the entries in a summary set of national accounts and then adjusting subsets of estimates to these controlling totals”. (Pyatt and Roe, 1977: xix, xxiii).

In turn, in the abstract to his article “A SAM approach to modeling”, Pyatt says: “Given that there is an accounting system corresponding to every economic model, it is useful to make the accounts explicit in the form of a SAM. Such a matrix can be used as the framework for a consistent dataset and for the representation of theory in what is called its transaction form”. In that transaction form (or TV (transaction value) form), the SAM can be seen “(...) as a framework for theory” and its cells “(...) can be filled instead with algebraic expressions, which describe in conceptual terms how the corresponding transaction values might be determined”. Thus, the SAM is used as “the basic framework for model presentation”. (Pyatt, 1988: 327; 337).

Looking at the question from the perspectives outlined above, it can be said that a SAM can have two versions: a numerical version, which describes the activity of a country empirically; and an algebraic version, which describes that same activity theoretically. In the former version, each cell has a specific numerical value, with the sums of the rows being equal to the sums of the columns. In the latter version, each cell is filled with algebraic expressions that, together with those of all the other cells, form a SAM-based model, the calibration of which involves a replication of the numerical version.

In the words of Pyatt, “the essence of (...) the SAM approach to modelling is to use the same SAM framework for both the empirical and the theoretical description of an economy”. (Pyatt, 1988: 337).

The construction of algebraic versions (or SAM-based models) can be seen, among others, in Pyatt (2001; 1988), Pyatt and Roe (1977), Pyatt and Round (2012; 1985) and Santos (2012; 2009).

Despite the potentialities of Stone’s work on SDMs, the SDM-based approach has not been followed by other authors as much as the SAM-based approach. Thus, the study of the SDM-based approach will be based only on Stone’s work.

According to that author, the population of a specific country in a specific year “flows in partly along time from last year, through survival, and partly along space from the outside world, through birth and immigration; and flows out, through death and emigration, and partly along time into next year, through survival” (Stone, 1986: 21). With the survivors from the preceding period constituting the opening stock of the population and the survivors into the succeeding period constituting the closing stock, the SDM can thus be considered a stock-flow matrix.

By connecting “the opening and closing stocks of year θ with flows during year θ ” (Stone, 1982: 292), two types of versions will be identified for the SDM: numerical versions, in which each cell has a specific numerical value; and algebraic versions, in which each cell is filled with algebraic expressions that, together with those of all the other cells, form a SDM-based model. Numerical versions of SDMs can thus be constructed from demographic statistics or they can be replicated by the running of SDM-based models. The former versions measure the reality under study and will be examined in the next section. The latter versions allow for the construction of scenarios resulting from experiments performed with those models, and can be seen in: Stone, 1966, 1971, 1973, 1975, 1981, 1982, 1985, 1986a.

Assuming that the core of the statistics representing the part of the activity of countries that can be expressed in currency units (covered by the SAM), and in human beings (covered by the SDM), are the national and the demographic accounts, respectively, at least as a starting point, their adoption is recommended for any study that is looking for empirical evidence about that activity. This will enable us to work with, and gain a greater knowledge about, the activity that is (supposedly) observed by the national and the demographic accounts, which, both in a SAM and a SDM framework, will benefit from the increased analytical content provided by the matrix format and the possibility of capturing and working with networks of linkages not

captured and worked on otherwise. The matrix format will also allow for the use of matrix algebra in possible mathematical treatments associated with the above-mentioned empirical work, enabling us to experiment with different interventions in regard to the functioning of reality.

3. Studying the Socio-Economics of Ageing with SAMs and SDMs

As mentioned above, this paper is supported by another study (Santos, 2013), which was not included here due to its length. That work includes a description and the methodological details necessary for the construction of the numerical versions of the SAM and SDM presented here. In turn, the description of the algebraic version of the SAM, used in the construction of the two scenarios presented below, can be found in Section 2.2.1 of Santos, 2012. Therefore, those two working papers should also be consulted for a better understanding of this Section.

Any study of the Socio-Economics of Ageing conducted in a specific space, namely, a country, should involve the consideration of its population and the corresponding age groups, together with the economic activity of those groups, which should involve the consideration of the origin and the destiny of the corresponding income. Under the current System of National Accounts (SNA 2008), all of the population in a country is represented by households – one of the five institutional sectors identified by that system, the others being: financial and non-financial corporations, government and non-profit institutions serving households. In keeping with what was said in the previous section, when all of the population of a country is worked upon within a SDM framework, its movements (expressed in numbers of human beings) can be represented in the form of a stock-flow matrix, which offers many possibilities for disaggregation, especially by age groups. In turn, the flows (expressed in currency units) representing the households' production, consumption and income can be worked upon within a SAM framework.

From what has just been said and bearing in mind the support offered by the above-mentioned working papers – Santos, 2012 and 2013 – SAMs and SDMs, and their underlying approaches, allow for the study of a wide range of different aspects involved in the Socio-Economics of Ageing (and many other areas), which can be identified in accordance with the purposes of each specific study. Let's suppose that, in studying possible social policy measures, we wish to identify some macroeconomic effects of changes in either the incomes or the expenditures of those whose retirement pensions are their main source of income.

Given such a purpose, our attention necessarily has to be focused, on the one hand, on those who are aged 65 and over, and who are recipients of pensions, i.e. retired and (supposedly) inactive individuals. On the other hand, we should also focus on the corresponding flows of income that are received and then spent by that group. The following exposition, illustrated by the example of an application to Portugal, will show a simple possible way of using the tools above presented in a study with that particular purpose.

Table 1: SDM for Portugal in 2009².

(Unit: 10³ individuals)

			Outside World	Population by age group and economic activity										Closing Stock	
				0-14	15-24			25-64			65 and over				
					Active	Inactive	Total	Active	Inactive	Total	Active	Inactive	Total		
				1	2	3		4	5		6	7		8	9
Outside World			1		5	5		5	22	3	25	42	39	81	10 638
Population by age group and economic activity	0-14		2	105	1 510										1 615
	15-24	Active	3	10		456									466
		Inactive	4		110		614								724
		Total			10	110			1 070						1 190
	25-64	Active	5	16		47		4 734							4 797
		Inactive	6				100		1 056						1 156
		Total			16			146			5 790				5 952
	65 and over	Active	7	0				35			284				320
		Inactive	8						73			1 488			1 561
		Total			0						108			1 772	1 881
Opening Stock			9	10 623	1 625	508	714	1 221	4 791	1 133	5 924	326	1 527	1 853	

Source: Statistics Portugal (*INE*).

In Table 1, we have a SDM for Portugal in 2009, with a disaggregation that is appropriate for the identification of the above-mentioned group of interest to us here. Thus, in column 8 and

² This table is Table 9 of Santos (2013), in which Appendixes C and D respectively provide details about the sources and the methodologies used in its construction.

row 8, we have the population aged 65 and over that is considered as inactive described in terms of their participation both in the labour market and in the supply side of the goods and services market. From the reading of this column, we can see that the opening stock of the inactive population aged 65 and over, measured in thousands of individuals, was 1,527 (14.4% of the total); of these, 39 either died or emigrated and 1,488 remained in the same situation throughout the year. Reading along the row for the same group we can see that the closing stock was 1,561 (14.7% of the total), which is composed of 73 individuals who moved from the inactive 25-64 age group and 1,488 who did not change their status.

In Table 2, we have a SAM for Portugal in 2009 with a disaggregation that is appropriate for identifying the incomes and expenditures of the same group of interest to us here.

Thus, in row 5 and column 5 we have, respectively, the receipts (or incomes) and the expenditures of the current account of the group of households classified as recipients of pensions regarding their main source of income³. Since the row and column totals are equal, they represent the aggregate income of that group, amounting to 25,578 million euros, and the corresponding totals of receipts and expenditures. This amount represents 10.2% of the total aggregate income. Reading along the row, we can see that this income derived from the compensation of labour and capital – 3,275 million euros (12.8 %) – while the remaining part came from current transfers within households, from the rest of the world and from the other institutional sectors – 22,302 million euros (87.2%). In this last figure, the part originating from government, i.e. pensions, represents 73.6%. Reading down the column, we can see that this income was mainly spent on final consumption – 18,778 million euros (73.4%), transferred in the form of current transfers within households, to the government (namely in the form of current taxes on income, wealth, etc), to the rest of the world and to other institutional sectors – 4,515 million euros (17.7 %). In the reading of the column, we can also see that the part of the aggregate income that was not spent on final consumption or transferred was saved, and amounts to 2,284 million euros (8.9%).

This SAM represents all the nominal flows (measured by the national accounts) that occurred in Portugal in 2009. Therefore, from this, we can calculate aggregates, indicators and balancing items, representative of the macroeconomic level of the activity of the Portuguese economy in that year. That is the case with what is normally considered to be the main macroeconomic aggregate, Gross Domestic Product at market prices (GDP_{pm}), amounting to 168,504 million

³ For a better understanding of the following reading, see Santos (2013) – Section 4.

euros. Since our SAM does not identify the institutional sectors in the production accounts, the part corresponding to our group cannot be identified in that amount, although such a calculation is possible in the case of both Gross National Income and Disposable Income. Therefore, in the case of total Gross National Income, with an amount of 161,639 million euros, the share of recipients of pensions was 2.03%, while in the case of total Disposable Income, with an amount of 162,800 million euros, the share of recipients of pensions was 12.94%.

In line with the above-mentioned purpose, for a better study of changes in either the incomes or the expenditures of those whose retirement pensions are their main source of income, two scenarios will be sketched out: scenario A, involving a change in incomes; and scenario B, involving a change in expenditures. The numerical SAM and SDM presented above will enable identification of those changes. Algebraic SAMs, representing accounting multipliers (as described in Section 2.2.1 of Santos, 2012) will enable us to quantify the macroeconomic effects of those changes, which will be summarised in the form of the changes occurring in the three above-mentioned macroeconomic aggregates – GDP_{pm}, Gross National Income and Disposable Income.

Taking advantage of the availability of the SDM, those scenarios will involve the increase noted between the opening and the closing stocks of the group of inactive individuals aged 65 and over. This increase could be calculated from cells (9,8 and 8,9) of Table 1 and was 2.2%.

If we assume that the *per capita* receipts and expenditures (considering the closing stock of our group) that can be calculated from the SAM and the SDM are the same, and that all the rest remains constant, the effects of that increase on the main items of income and expenditure of our particular group of interest will constitute scenarios A and B, respectively.

As was seen above, the main item of income in our group of individuals is pensions, which amount to current transfers from the government. Scenario A will therefore show the effects of an increase in current transfers from the government, resulting from an increase of 2.2% in the group of inactive individuals aged 65 and over, with the received *per capita* amount remaining the same. Considering the value of cell (5,9) of Table 2, this would represent an increase of approximately 420 million euros in the amount of current transfers from the government to the recipients of pensions. Since the current and capital accounts of the government, as well as the financial and the rest of the world accounts, are considered exogenous, from the running of the accounting multipliers, calculated from the SAM for Portugal in 2009, it can be seen that the effect of such a change on the endogenous part of the SAM showed an increase of 0.31% in

GDP_{pm}. At the level of Gross National Income, this effect represents an increase of 0.30% in total income and a rise of 0.29% in the share of the recipients of pensions. In turn, the effect on Disposable Income also took the form of an increase of 0.29% in total income and 2.67% in the share of the recipients of pensions.

In turn, scenario B will represent the effect of an increase in final consumption resulting from an increase of 2.2% in the group of inactive individuals aged 65 and over, with the consumed *per capita* amount remaining the same. Considering the value of cell (1,5) of Table 2, this would represent an increase of approximately 378 million euros in the final consumption of the recipients of pensions. Since the current and capital accounts of the two groups of households, as well as the financial and the rest of the world accounts, are considered to be exogenous, from the running of the accounting multipliers, calculated from the SAM for Portugal in 2009, it can be seen that the effect of such a change on the endogenous part of the SAM now represents an increase of 0.18% in GDP_{pm}. The effects on Gross National Income (both in total and in the part relating to the share of recipients of pensions) and on total Disposable Income was an increase of 0.17%, whereas, in the part of Disposable Income that relates to the recipients of pensions, there was an increase of 0.11%.

As far as the SAM algebraic version used in the construction of the above scenarios is concerned, the accounting multipliers are based on assumptions that limit the results and the subsequent analysis of the constructed scenarios, as shown by Santos (2012). However, this methodology is very simple to apply and, from the author's point of view, it represents a good way of exemplifying the aspects that we intended to highlight in this paper. On the other hand, some types of algebraic versions of the SDM could also have been adopted, together (or not) with the SAM.

Much work can be undertaken with SAM and SDM-based approaches in studies in many different areas, particularly in the field of the Socio-Economics of Ageing.

Table 2: SAM for Portugal in 2009⁴

Outlays (expenditures) 			
--	--	--	--

Sources: Statistics Portugal (*INE*); Portuguese Central Bank (*Banco de Portugal*).

⁴ This table is, in fact, Table 3 of Santos (2013) showing the households' current account disaggregated by main source of income – rows 5 and 6 and their respective columns, represented in italic font. This disaggregation is an estimate, adopting the same structure of the same account in the SAM worked upon in Santos (2009).

Table 2: SAM for Portugal in 2009 (continued)

Outlays (expenditures) <				
---	--	--	--	--

Table 2: SAM for Portugal in 2009 (continued)

(Unit: 10⁶ euros)

Outlays (expenditures) 			
--	--	--	--

4. Concluding remarks

The Social Accounting Matrix (SAM) and Socio-Demographic Matrix (SDM) are tools that can be used for studying the activity of countries both empirically and theoretically, depending on whether they are presented in a numerical or algebraic version. These are the so-called SAM-based and SDM-based approaches for studying (measuring and modelling) the activity of countries.

Using the example of a numerical version, the analysis of the activity of Portugal in 2009 was geared towards the study of some aspects of the Socio-Economics of Ageing. Using an algebraic version of the SAM, the performance of a number of experiments allowed for the analysis of two scenarios that resulted from changes in that same reality. In that example, our attention was focused on the section of the population aged 65 and over, namely, on those who were already retired, inactive, and recipients of pensions. In the case of that population group, our attention was also focused on the flows of income that represent their receipts and expenditures. With our working tools, for the year under study, it was possible to quantify the flows of the population of the country, by age groups and economic activity. On the other hand, for those groups, it was also possible to identify the corresponding income and expenditures and the underlying structures. From the two scenarios that were experimented with, it was possible to exemplify how the macroeconomic effects of changes in those groups and in the corresponding components of income and expenditure can be quantified. Therefore, with our illustrative application, the above-mentioned approaches and the underlying work undertaken in the matrix format allowed for the capture of some multiplier effects and the subsequent quantification of some macroeconomic effects resulting from changes in the flows of income and expenditure of the Portuguese recipients of pensions in 2009. Those effects were summarised outside the matrix format through the quantification of changes in the GDP_{pm} , Gross National Income and Disposable Income.

Criticisms can be made, not only of the way in which the above experiments were performed, but also of the constraints imposed by the accounting multipliers (SAM-based model). This was, however, just a simple example of what can be done with the working tools of the SAM and the SDM. With this presentation, from the working papers that supported it (Santos, 2012 and 2013) and the given references, the author hopes to have been able to draw attention to the potentialities of the SAM and SDM-based approaches and to show that much more can be done beyond the example presented.

References

- Pyatt, G. (1999), "Some Relationships between T-Accounts, Input-Output Tables and Social Accounting Matrices", *Economic Systems Research*, 11, 365-387.
- Pyatt, G. (1988), "A SAM Approach to Modeling", *Journal of Policy Modeling*, 10, 327-352.
- Pyatt, G. and Roe, A.(1977), *Social Accounting for Development Planning with Special Reference to Sri Lanka*, Cambridge University Press, Cambridge, UK.
- Pyatt, G. and Round, J. (2012), "Distributional Invariance and the Design of SAMs", *Economic Systems Research*, 24, 251-273.
- Pyatt, G. and Round, J. (1985), "Accounting and Fixed Price Multipliers in a Social Accounting Matrix Framework", in G. Pyatt, and J. Round, (coord.), *Social Accounting Matrices. A Basis for Planning*. A World Bank Symposium, World Bank, 52-69.
- Santos, S. (2013) Socio-Economic Studies with Social Accounting and Socio-Demographic Matrices. An application to Portugal. Working Paper No.16/2013/ DE (Departamento de Economia) /UECE (Unidade de Estudos sobre a Complexidade em Economia) - ISEG (Instituto Superior de Economia e Gestão) /UL (Universidade de Lisboa), 44p.
- Santos, S. (2012) "A SAM (Social Accounting Matrix) approach to the policy decision process". Working Paper No.28 /2012/ DE (Departamento de Economia) /UECE (Unidade de Estudos sobre a Complexidade em Economia) - ISEG (Instituto Superior de Economia e Gestão) /UTL (Universidade Técnica de Lisboa), 83p.
- Santos S. (2009), *From the System of National Accounts (SNA) to a Social Accounting Matrix (SAM)-Based Model. An Application to Portugal*, Edições Almedina, Coimbra-Portugal, 194p.
- Stone, R. (1986), "Nobel Memorial Lecture 1984. The Accounts of Society", *Journal of Applied Econometrics*, 1(1), 5-28.
- Stone, R. (1986a), "Demographic Input-Output: An Extension of Social Accounting", in: I. Sohn (coord), *Readings in Input-Output Analysis: Theory and Applications*, Oxford University Press, USA, 151-172.

Stone, R. (1985), “The Disaggregation of the household Sector in the National Accounts”, in G. Pyatt, and J. Round, (coord.), *Social Accounting Matrices. A Basis for Planning*. A World Bank Symposium, World Bank, 145 - 185.

Stone, R. (1982), “Working with what we have: how can existing data be used in the construction and analysis of socio-demographic matrices?” *Review of Income and Wealth*, 28(3), 291-303.

Stone, R. (1981), *Aspects of Economic and Social Modelling*, Editions Droz, Genève (Suisse), 154p.

Stone, R. (1975), “Towards a System of Social and Demographic Statistics”, *Studies in Methods*, Series F, N°18, United Nations, New York, 198p.

Stone, R. (1973), “A System of Social Matrices”, *Review of Income and Wealth*, 19(3), 143-166.

Stone, R. (1971), “An Integrated System of Demographic, Manpower and Social Statistics and its Links with the System of National Economic Accounts”, *Sankhyā: The Indian Journal of Statistics*, 33(1-2), 1-184.

Stone, R. (1966), “The Social Accounts from a consumer's point of view. An outline and discussion of the revised United Nations System of National Accounts”, *Review of Income and Wealth*, 12(1), 1-33.